Skagit Fisheries Enhancement Group

Lesson Plan 2016

SKAGIT FISHERIES
ENHANCEMENT GROUP

Table of Contents

Goals and Objectives

1. Middle school students in the Skagit and Samish River watersheds will build a lifelong connection between individuals, communities, and the natural world.
    A. Identify parallels between their own lives and the natural world.
    B. Acknowledge complexity of individuals and communities, both natural and human (systems thinking).
2. Middle school students in the Skagit and Samish River watersheds will gain a sense of place while experiencing different facets of learning.
    A. Confidently express ideas through artistic, written, verbal and physical expression.
    B. Demonstrate comprehension of topics through creative expression in individual field journal.
    C. Identify local Pacific Northwest flora and fauna.
3. Middle school students in the Skagit and Samish River watersheds will cultivate an ethic that values sustainable practices and stewardship.
    A. Appreciate the environment while being socially conscious and environmentally literate about sustainability and stewardship.
    B. Gain self-appreciation for the stewardship each individual student accomplishes during their projects.

Institutional Partners and Learners

Skagit Fisheries Enhancement Group (SFEG) is a non-profit organization located in Mount Vernon, Washington. SFEG is one of 14 Regional Fisheries Enhancement Groups (RFEGs) in Washington State, developed in 1990. With each enhancement group focusing on a different watershed, habitat restoration projects are funded by private and public competitive grants, fundraising, and private donors. SFEG's mission is to *build partnerships that educate and engage community in habitat restoration and watershed stewardship opportunities in order to enhance salmon populations*.

The Junior Stream Stewards (JSS) program started in 2006, piloted at Concrete Middle School. The program is funded in large part by Washington State Department of Fish and Wildlife's Aquatic Land Enhancement Account (ALEA) grant. This funding is specifically for aquatic lands enhancement which engages community volunteers, and funds many local educational programs. There are also many other grants that help this program including grants from Skagit County, Department of Ecology, Skagit Community Foundation, and more.

The students that take part in the Junior Stream Stewards program come from a wide range of backgrounds. Their ages generally range from 12-14 and they are in grades 6-8. The students also come from a diverse area speaking several languages. Since SFEG serves the Skagit Watershed (including Darrington), Samish Watershed, San Juan Islands and Northern Whidbey Island, there is a great opportunity to work with many schools and many students.

Location

The locations of the program vary depending on the school. There are a total of 9 class visits, 7 of which take place in the classroom. There are two field trips: the first, in November, is a watershed tour in which the students visit different sites where they can evaluate water quality and salmon habitat in their local watershed. The second field trip is a service-learning project in which the students go to a local riparian area and restore the salmon habitat, typically by planting trees. These field trips add to the overall goals, expectations, and experiences of the program. All field trips are funded through the program.

Theme

Stewardship!

The students will go on a journey to learn what it means to be a steward of their local watershed. They will learn what comprises a healthy watershed including animals, plants, insects, water, and much more. They will learn what a watershed is and how they can personally help keep it healthy and happy for future generations. Through classroom learning and field trips the students will experience what it means to be a stream steward.

Rules and Expectations

Students and Teachers of the JSS program

- Be respectful to all people, animals, plants, and property
- Be present emotionally, physically, and mentally
- Come to activities prepared and on time
- Closed-toed shoes are required at all times on field trips

Students of the JSS program

- All school rules apply in class and on field trips
- Listen and be respectful to all teachers and facilitators

Risk Management for Fieldtrips

General:

Hazard	Risk	Strategy to Minimize Risk	Further Action
Drinking Water	Dehydration	Staff will be mindful of water consumption and constantly remind students to hydrate.	Staff will educate students about the dangers of dehydration and provide a variety of interesting ways to keep them hydrated. Staff will model good hydration behavior.
Sun Protection	Sunburn	Students will be encouraged to wear hats and sunscreen.	Staff will educate students as how to keep themselves safe from the sun and provide shady locations.
Bees	Stings	Everyone will be mindful of bee and wasp conditions. Staff will be aware	If any person is allergic, they must carry an EpiPen
Weather	Wind- tree fall Storm- Thunder & Lightning	Staff will be aware of weather danger at all times and remind students	Some fieldtrips may be canceled due to weather conditions. Carry rain gear.
Stream	Slip and fall	Staff will be mindful of stream conditions and remind students of these conditions	If students are not complying with staff and teacher commands, students will be removed from stream. There is also always a CPR and first aid certified person on site.
Uneven trails	Rolled Ankles/ Minor falls and tripping	Be mindful of terrain; explain threat that trail poses to students. Keep a slow,	Encourage students to pay attention to their surroundings and to be aware of their physical ability.
Muddy/ Slippery Trails	Slipping on/off trail	Be mindful of terrain- explain threat that mud poses to students. Keep a	Encourage students to pay attention to their surroundings and to be aware of their physical ability. Also encourage students to watch out for each other.
Proper Footwear (Hiking Boots/ water resistant)	Blisters/Hot spots, wet/cold feet, rolled ankles, poor traction on trail	Establish open communication and understanding about trail conditions as well as when students need assistance. Staff always brings extra socks.	Talk before trip- make sure students have as close to proper footwear as possible. Open dialogue about shoes throughout week. Ensure that wet shoes are drying over night as best they can.
Proper Clothing	Cranky students, susceptibility to illness, extremely un-	As much synthetic layering as possible. Minimum cotton, maximum layers.	Discuss the importance of non-cotton clothing with students before the trip multiple times. Encourage students to bring/carry extra layers at all times.
Tool Safety	Injuries	Everyone will attend safety instruction led by SFEG staff or volunteer	All students will be supervised while using tools

Contacts

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Lucy DeGrace, Outreach Manager: (360) 336- 0172 ext 301; cell: (360) 853- 5893

Alison Studley, SFEG Executive Director: (360) 336- 0172 ext 302

WSC, Education Associate: *Varies by year*

WSC, Outreach Associate: *Varies by year*

Education Interns: *Varies by year*

Schedule

September- Watersheds

October- Salmon Biology

November- Watershed Tours (Water Quality)

December- BREAK (optional art project)

January- Salmon Lifecycle

February- Riparian Zones

March- Stewardship Projects

April- Salmon Species

May- Macroinvertebrates

June- Review

What is a Watershed?

Grade Level: 6-8

Subject areas: Science, Geography

Duration: 1 hour

Group size: 20-30 students

Setting: Classroom

Key Terms: Watershed, salmon, ridges, peaks, valleys, systems

Appendices: Attached PowerPoint presentation and JSS journal with map.

Objectives:

Students will be able to explain what a watershed is, its parts, and in which watershed their school is located.

Method:

Students will participate in a PowerPoint based discussion, answer questions in their journal, and then participate in an activity where they can create their own watershed.

Materials:

- PowerPoint presentation
- Blank sheets of copy paper (one per student)
- Water based markers (three different colors per student)
- 2-3 spray bottles filled with water
- Junior Steam Stewards (JSS) journal with watershed map

Background:

A **watershed** is a drainage basin formed when rain or precipitation falls onto the ridges/tops of mountains and flows downward where it collects in a common body of water; a lake, river, stream, etc. The tops of the mountains/ridges form the watershed boundary.

A watershed is a system comprised of multiple parts working together. The watershed system is made up of mountain peaks, ridges, valleys, glaciers, waterfalls, streams and everything in between. The rain and snow fall within the boundary and contribute water to these glaciers, waterfalls, and streams. This water then collects at the lowest point within the boundary (the lake, stream, or river).

There are also small watersheds within larger watersheds. Each school is located in a different watershed. They are all considered part of the Salish Sea Watershed and they may be part of the Skagit River Watershed, the Samish River Watershed, or neither. Their smaller more local watersheds are listed below:

- Cascade Middle School– Brickyard Creek, Skagit River
- Bayview School: Joe Leary Slough, Padilla Bay
- Edison School: Edison Slough, Samish Bay
- Concrete Middle School: Lorenzan Creek, Skagit River
- Conway School: Hill Ditch, Skagit River

Other things that are noted in the PowerPoint are that the Skagit River is the largest river in Puget Sound, third largest on the west coast of the continental U.S.A. (following the Columbia and Sacramento rivers), drains over 3,000 square miles of land and is 120 miles long.

Preparation:

1. Prepare PowerPoint, make sure it is in working order before presentation.
2. Prepare all materials, make sure you have enough paper, markers, JSS journals, and watershed map.

Procedure:

Presentation

1. *(0-2 minutes)* Gather class' attention, welcome them to their first JSS unit, Watersheds.

2. (2- 7 minutes) Have teacher or assistant pass out JSS journals and maps. Continue onto slide two of the PowerPoint. Explain to the class what Skagit Fisheries Enhancement Group is. It is a non-profit organization dedicated to restoring wild salmon populations through education, community involvement and habitat restoration.

3. *(7– 10 minutes)* Have students turn to page 1 in journal and continue onto next slide. Explain to the students that SFEG is in their class today to teach them what a watershed is, which one their school is located in, and why it is relevant (this information is listed in the "background" section). Share with the class what you are going to be doing over the school year. A SFEG staff person will come in once a month and teach a different unit. There will be two fieldtrips for each school (except Cascade), a watershed tour in November and service project in March.

4. *(10– 14 minutes)* Continue to next slide of PowerPoint. Define watershed (refer to "Background" section) and go through some of the key words listed on the slide: ridges, watershed boundary, etc. Have the students write the definition in the space provided in their journals.

5. *(14- 20 minutes)* Pick five volunteer students, a range of heights, one being the tallest person in the class. In front of the class arrange these students in a horseshoe shape with the tallest person in the middle of the curve of the horseshoe. Have the students stick their arms out in front of them creating a basin. The students have now made themselves into a watershed with the tallest person being the tallest mountain and all other students being surrounding mountains. Their heads are now creating the watershed boundary of their new watershed. Ask the students to explain what would happen if you dumped a bucket of water on the volunteer mountains' heads. If you did dump the bucket, most water would pour over their heads and down their arms. This is how a watershed works. You can also explain that some water would hit their heads and go down their backs and this would be flowing outside their watershed boundary, into another watershed. You can now have the volunteers sit down.

6. *(20-22 minutes)* Continue onto the next slide. Use the watershed picture as another form of communicating to the students what a watershed is, i.e. a visual representation of a watershed. Point out the watershed boundary, ridges, streams, where is the water flowing (blue lines), etc. Introduce the concept of little watersheds inside bigger watersheds, Like the picture shows. You can compare it to a dart board, one circle inside another is like one watershed inside another. Ask the class if the bear is in the watershed or outside the watershed (he is outside), how about the sasquatch/orangutan (he is also outside).

7. *(22– 25 minutes)* Go to the next slide. Ask the students to give you an example of a system. (solar system, respiratory system, nervous system, ecosystem, etc). Give them some examples if they need some nudging. Define what a system is in science, basically multiple parts working together to function as a whole. Machines are good examples too.

7. Continued… Explain how a watershed is a system. The mountains peaks, ridges, glaciers, water, weather, all work together to create and maintain a watershed.

8. (*25– 29 minutes)* Step 8 only applies to schools in Skagit River Watershed. If school is not part of Skagit River watershed skip to Step 9. If the school is part of the Skagit River then show the three facts listed on the next slide. Skagit River is the third largest watershed on the west coast of the continental U.S. Ask if anyone knows what the other two are? Then ask the class if anyone knows where the Skagit River starts. Did they know that it starts in British Columbia, Canada? The next slide is a picture of the Skagit River watershed. Have the students tell you what the red line represents (watershed boundary), what about the blue lines (water, streams, rivers)?

9. *(29- 34 minutes)* Now ask the students what watershed they are in. Many will say Skagit, which for some is correct. Ask them if they remember you saying earlier that there are smaller watersheds inside bigger ones? The class is in the Salish Sea watershed, and then further Cascade, Concrete, and Conway are in Skagit River, Bay View in Padilla Bay, and Edison in Samish Bay. What is the smallest watershed they are in? What is their nearest body of water? Go to the next slide and it will reveal the watershed they are in (dependent on school, listed in "background information"). Have the class write their watershed in their journals in the space provided. Ask the students if they have seen the body of water, and have them share some stories if time allows.

10. *(34- 38 minutes)* Have the students pull out the watershed map from their journals and flip to the next slide. Show them their watershed on the map. Have them label their school, house, or whatever they recognize on the map.

11. *(38- 40 minutes)* Continue to next slide. Ask the class if they have seen the objects in the pictures before (storm drains, decals, stencils, etc.). Where have they seen them? Ask them to tell you where the water that flows into the storm drains goes to? The nearest body of water is correct. Let them know that all the water (containing oil, chemicals, pollution, etc.) from their parking lot and property is going through their storm drains and into their watershed, untreated! What effect does that have?

Activity

12. *(40– 42 minutes)* Have class put away everything on their desk and ask teacher or assistant to pass out one piece of paper and three markers per student.

13. *(42- 45 minutes)* While demonstrating, have the students lightly crumple up their piece of paper. Then have them very slightly uncrumple it so it looks like the paper is now mountains and valleys.

14. *(45– 47 minutes)* Have the students use one marker, preferably the darkest color, and highlight only the ridges and peaks of the mountains or the highest points of their paper. They don't have to highlight all of them, just the largest most noticeable ones.

15. *(47– 49 minutes)* Now take a second color and highlight all of the valleys or indents/ lowest parts of their paper.

16. *(49– 51 minutes)* For their last color marker, have them draw buildings, school, offices, houses, people, anything they want wherever they want.

18. *(51– 55 minutes)* Now that their watershed is complete, take a spray bottle (prefilled with water) and tell them a storm is coming. Go around and lightly spray the students' paper with water.
19. *(55– 60 minutes)* Once all of the students' papers have been sprayed, discuss what happened. Have them raise their hands and tell the class what they observed once the storm hit their watershed. Did some of their buildings flood? Have them write their observations in their journals. There are some prompts to some questions in their journals to help them participate in the discussion.

Extension:

As an extension, you can review the five species of Pacific salmon (chum, coho, Chinook, sockeye, pink). You can also discuss how the watersheds now compare to 100 years ago.

Evaluation:

Before the first unit of the JSS program, a pre-survey is handed out to each student. On this survey there are questions pertaining to this unit. There will be a post–survey handed out to the students at the end of the JSS program. This survey will have the same questions as the pre-survey. You can see if the students retained the information if the scores of each student increase from the time of the pre-survey to the post-survey.

Next Generation Science Standards

Performance Expectations
MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. **MS-ESS3-3**. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• Developing and Using Models • Constructing Explanations and Designing Solutions • Asking Questions and Defining Problems	• ESS2.A: Earth's Materials and Systems • ESS2.C: The Roles of Water in Earth's Surface Processes • ESS3.C: Human Impacts on Earth • ESS3.D: Global Climate Change Systems	• Cause and Effect • Systems and System Models • *Connections to Engineering, Technology, and Applications of Science* Engineering, and Technology on Society and the Natural World. • *Connections to Nature of Science,* Science Addresses Questions About the Natural and Material World

How is a Salmon Adapted for its Environment?

Grade Level: 6-8

Subject areas: Science, Biology

Duration: 1 hour

Group size: 20-30 kids

Setting: Classroom

Key Terms: scales, fins, gills, external, internal, all bolded terms listed under background section

Appendices: JSS journal

Objectives:

Students will be able to identify the external and internal parts of a salmon and explain the function of each part.

Method:

By using pictures, discussion, and a salmon dissection demo, the students will make physical observations about the external and internal parts of a salmon.

Materials:

- Whiteboard
- Dry erase marker(s)
- Fresh salmon
- Cutting board
- Fillet/ fishing knife
- Apron
- Tablecloth/plastic sheeting
- 6-8 Plastic containers
- 2+ heavy duty garbage bags
- Paper towels
- JSS journal

Background:

General knowledge of the internal and external parts of a salmon and their functions are necessary and listed below.

External

- **Dorsal fin-** used to balance and remain upright
- **Tail/ Caudal fin**– used to propel forward; powerhouse
- **Caudal peduncle**– where catch-and-release fisherman should hold their catch, connector to the tail/ caudal fin
- **Pectoral fins**– used to stop and steer left and right
- **Pelvic fins**– used to steer left and right, as well as maintain position
- **Anal fin-** used to balance and remain upright
- **Adipose fin**– No known use; clipped off hatchery fish
- **Eyes-** vision
- **Nostrils**– smell
- **Gill cover/ Operculum**– protects gills
- **Lateral line**– sensory organ used to detect motion in the water
- **Scales**– used as armor to the fish, can also tell their age

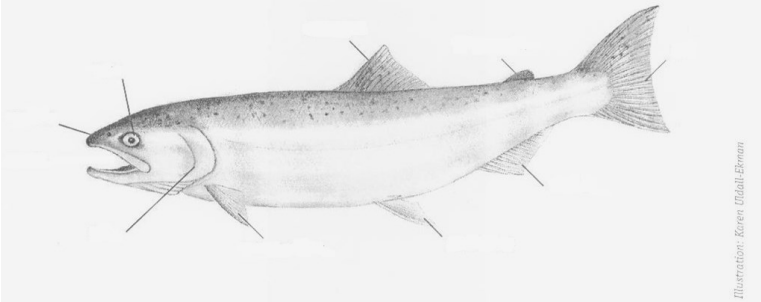
Internal

- **Brain**– used to think and coordinate movements, control center for nervous system
- **Gill rakers**– rigid, comb-like structure used to protect gills from debris and food
- **Gills**– dark red feathery structure that absorbs oxygen as water passes over
- **Heart**– organ used to pump/ circulate blood through the body
- **Intestine**– organ that extends from stomach to vent, used to digest food and absorb nutrients
- **Kidney**– used to process toxins, remove waste, and produce urine
- **Liver**– organ used to aid digestion and excretion
- **Ovaries**– female reproductive organ that produces eggs
- **Pyloric caeca**– digestive organ

- **Spinal cord**– bundle of nerves that transmit messages from brain to rest of the body
- **Spleen**– organ in which white blood cells are produced and red blood cells are recycled
- **Stomach**– sac like organ that breaks down food before it moves on to the intestine
- **Swim Bladder**– sac located just below the spine that fills and releases gas, used to control buoyancy
- **Testes**- male reproductive organ that produces and stores milt
- **Urinary bladder**– sac to store urine
- **Vent**– external opening of digestive system in which urine, feces, eggs and milt exit the body

Preparation:

1. Depending on which hatchery has fish (Samish or Marblemount), the morning of the unit, you must go get one fresh, dead salmon per class. Place fish in cooler for the day.
2. Arrive to school at least 10 minutes early for set-up.
3. Cover table used for dissection with tablecloth or plastic sheeting.
4. Place clean cutting board, knife, and containers on the table.
5. Person dissecting may want to put apron on.
6. Draw salmon outline on whiteboards with lines pointing to all external parts of fish. DO NOT LABLE YET. Should look something like this:



Procedure:

1. *(0– 2 minutes)* Welcome class back to JSS and introduce them to unit 2 Salmon Biology. Ask them if they can remember the SFEG staff and/or if they can guess what we are going to do?
2. *(2– 5 minutes)* Start with a review on what you covered last time. Ask the class what is a watershed, what watershed are they in, any questions relating to the watershed lesson.
3. *(5– 30 minutes)* Now, refer to the whiteboard salmon diagram and have the students raise their hands and label the body parts. Have them write the body parts in the appropriate spot in their JSS journal. Have them tell you the function of each body part they name and write the functions in the appropriate spot in their journal. Once they cannot name any more organs, go over the remaining missing labels with the class. Make sure they are writing all parts and functions in their journals.
4. *(30– 35 minutes)* Get the fresh, dead fish out of the cooler and go over the external body parts and their functions again using the real fish as a reference. Have the class tell you what the parts and functions are as you point them out on the fish. Ask them if the fish is hatchery or wild? They should know by the presence or absence of the **adipose fin.** See if they can identify the salmon species.
5. *(35– 36 minutes)* Place fish on cutting board. Ask the class if they think it is a male or female, and why. Once all students have made their guesses cut the fish from the pectoral fins to the vent; at this point the gender may become immediately obvious, if eggs/milt spill out (on very ripe fish). Cut the fish by gently slicing away at the layers of skin so as not to puncture or sever the organs.

6. (36– 50 minutes) Pulling out one organ, piece, or internal part of the fish at a time, identify all parts and either let the students tell you the function, or you tell them the function. Go into detail, how is human activity effecting the fish physically? Place each organ, piece, or internal part separately (including milt/testes and eggs/ovaries) into the provided containers.
7. *(50- 60 minutes)* Once all parts have been removed from fish and discussed as a class, pass out all containers to the class. Allow them to see and touch the fish pieces in the containers. In small groups , allow students to come up and view and touch the salmon body.

Extension

You can also pull out a lens from the eye and give students time to ask more questions.

Directions to access brain: Hold fish firmly with its belly down and dorsal fin towards the ceiling. Cut about a half inch straight down over the back of the gill covers. Slice at an angle from just behind the nostrils to the bottom of your first cut. Remove the wedge of the head created. The brain should appear as a pink blob inside an opening in the skull. If you can't see the brain check the chunk you removed in case you cut too deep. If it isn't in that section, slowly slice away at the head until the brain is exposed. It is usually the size of a large pea.

Evaluation

Before the first unit of the JSS program, a pre-survey is handed out to each student. On this survey there are questions retaining to this unit. There will be a post–survey handed out to the students at the end of the JSS program. This survey will have the same questions as the pre-survey. You can see if the students retained the information if the scores of each student increase from the time of the pre-survey to the post-survey.

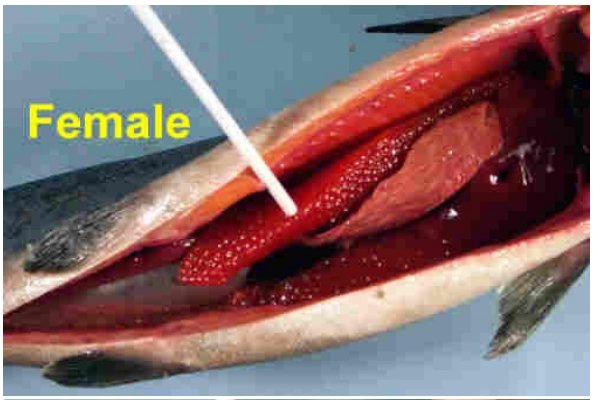
Next Generation Science Standards

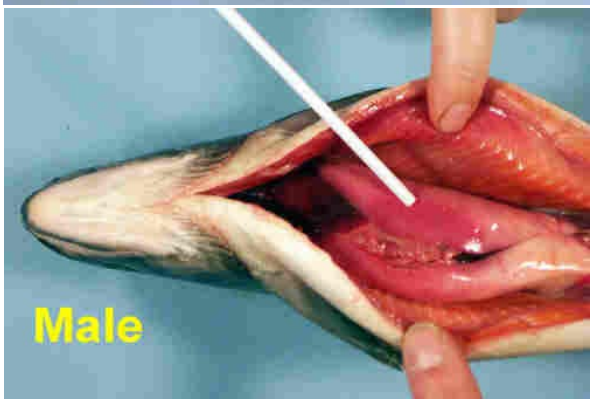
Performance Expectations
MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. **MS-LS1-4.** Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. **MS-LS1-5.** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. **MS-LS4-4.** Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment..

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• Constructing Explanations and Designing Solutions • Obtaining, Evaluating, and Communicating Information	• LS1.B: Growth and Development of Organisms • LS4.B: Natural Selection • LS4.C: Adaptation	• Cause and Effect • Systems and System Models • *Connections to Nature of Science,* Science is a Human Endeavor • *Connections to Nature of Science,* Scientific Knowledge Assumes an Order and Consistency in Natural Systems • *Connections to Nature of Science,* Science Addresses Questions About the Natural and Material World

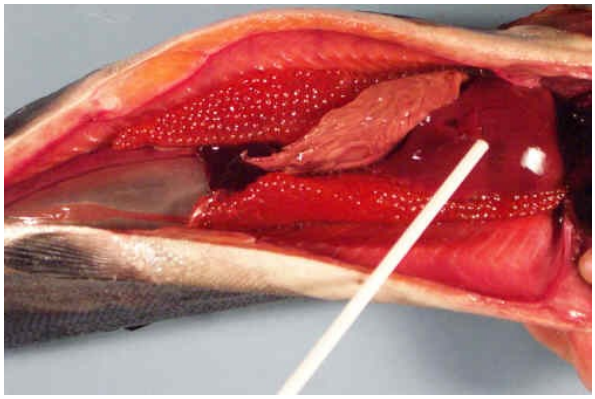
Pictures of Internal Anatomy:

- Ovaries and Testes

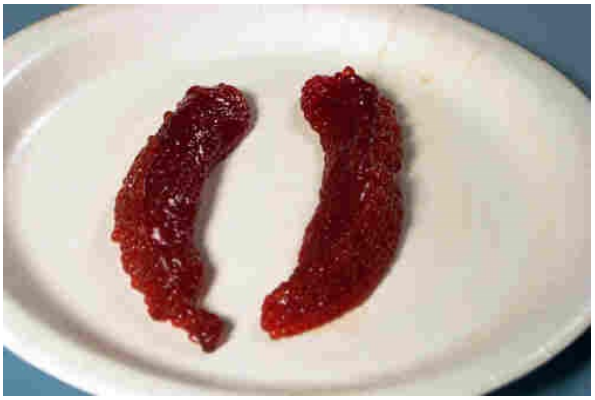


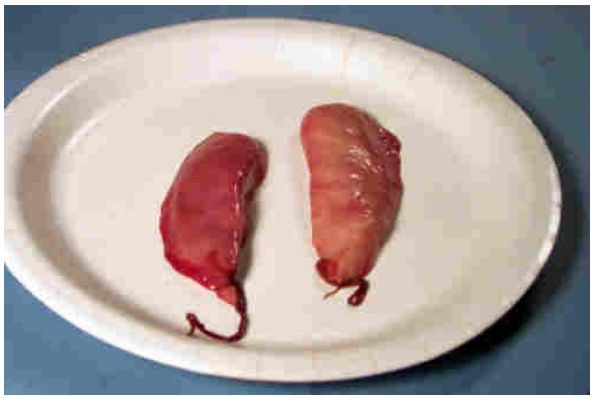


- Liver



- Eggs and milt

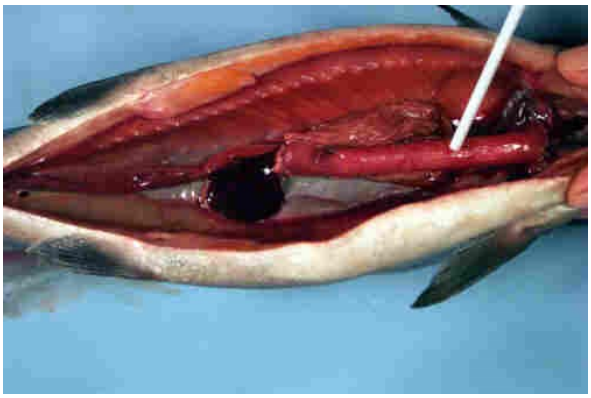




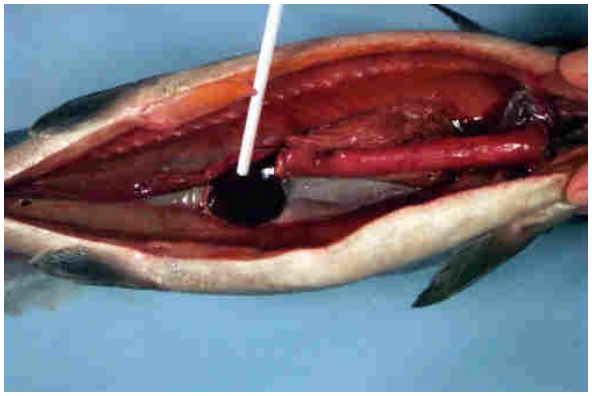
- Digestive system

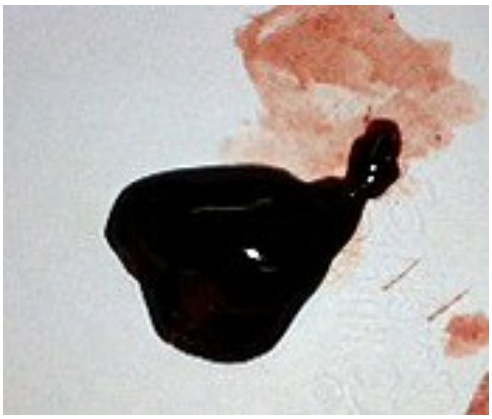
Pictures of Internal Anatomy Continued:

- Stomach

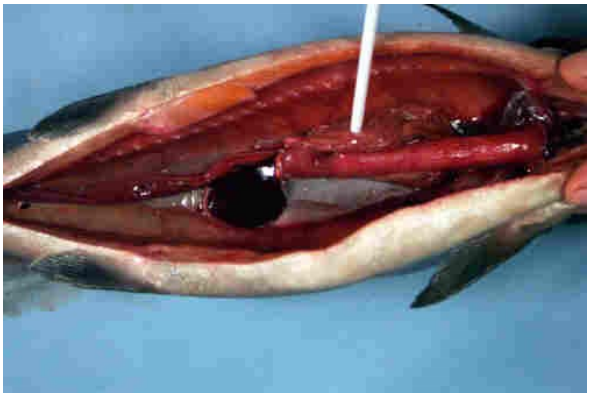


- Spleen

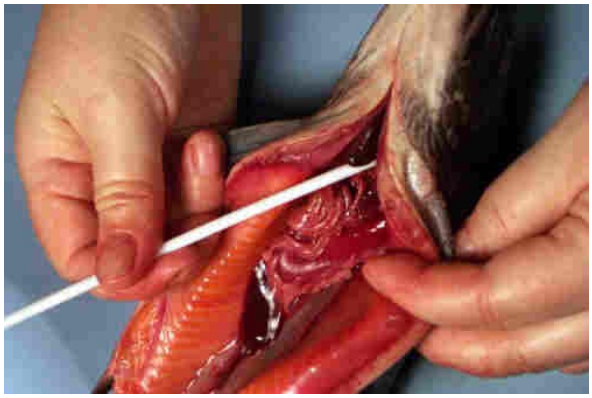




- Pyloric Cecea



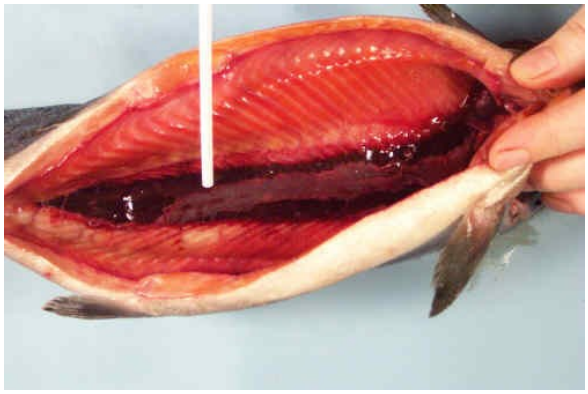
- Heart



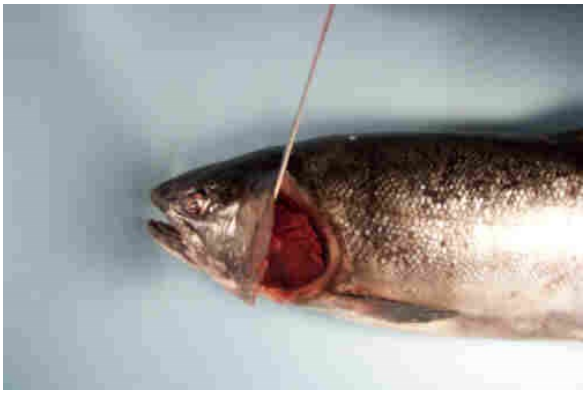
Pictures of Internal Anatomy Continued:

- Swim Bladder

- Kidney



- Gill rakers and Gills



- Eye

- Brain

How is the Water Quality in Your Watershed?

Grade Level: 6-8

Subject areas: Science, Environmental Education

Duration: 1-3 hours

Group size: 20-30 kids

Setting: Outside, multiple sites

Key Terms: Dissolved oxygen, temperature, pH, turbidity, ppm, and JTU

Appendices: Dissolved Oxygen, pH, temperature (Fahrenheit and Celsius), and turbidity test kits and visual aids, and JSS journal

Objective:

By the end of the watershed tour field trip the students should be able to determine the quality of the water at multiple sites while exploring their local watershed.

Method:

The class(es) will load onto a bus and go to multiple locations within the same watershed as their school. At each site the students will split into three groups (same groups each site) and measure the dissolved oxygen, temperature, pH, and turbidity of the water at each site. They will also assess the habitat by looking for other signs of good or bad salmon habitat.

Materials:

- Bus
- Clipboards (one per student)
- Pencil (one per student)
- Water quality data sheet (one per student)
- Dissolved oxygen test kit
- pH test kit
- Turbidity test kit
- Two thermometers (one Fahrenheit and one Celsius)
- Water scoop

Background:

Traditional testing sites for each school are listed below:

- Bayview– Port of Skagit (three sites) and Joe Leary Slough
- Cascade– Done in class
- Conway– Lake Sixteen, Starbird, and Fisher Creek
- Concrete– Multiple sites on Lorenzan Creek
- Edison– Ennis Creek, Silver Creek, Friday Creek, and Edison Slough

The definitions of the characteristics being tested in the water and why these are important to salmon and other wildlife, is listed below:

Dissolved oxygen- (DO) refers to microscopic bubbles of gaseous oxygen (O_2) that are mixed in water and available to aquatic organisms for respiration—a critical process for all organisms that need oxygen to breathe.

⇒ Salmon need at least 6 parts per million (**ppm**) DO

Temperature- the degree or intensity of heat present in a substance or object, especially as expressed according to a comparative scale and shown by a thermometer or perceived by touch— all organisms need specific temperature range for optimal health.

⇒ Salmon need between 5-20 degrees Celsius/ 40-68 degrees Fahrenheit.

pH- a figure expressing the acidity or alkalinity of a solution on a logarithmic scale on which 7 is neutral; lower values are more acidic, and higher values more alkaline. Too low or too high can kill aquatic life

⇒ Salmon need a pH between 6.5 -8.2

Turbidity- the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in the air—

If turbidity is too high fish cannot see or breathe because particles are clogging their eyes and gills.

⇒ Salmon need less than 25 Jackson Turbidity Units (**JTU**)

Preparation:

1. Bus must be reserved ahead of time by teachers.
2. A permission slip must be sent home with students and returned prior to field trip. The parental permission slip must inform parents and students about appropriate weatherproof clothes, closed-toe shoes, and instruct them to bring a pencil, a sack lunch and plenty of drinking water.
3. Make sure you have enough chemicals in each test kit, if not, order more ahead of time.
4. Make sure you have enough clipboards, extra pencils, and data sheets for each student to have one.
5. Have teacher split the class(es) into three groups (each group will be together for the entire field trip).

Procedure:

1. *(Time varies)* While still in classroom, welcome students to unit 3 and their first field trip, Watershed Tours and Water Quality. Have them review what they learned and observed during the previous unit, Salmon Biology.
2. *(Time varies)* Have students gather their things for the field trip, use restrooms, and load onto the bus.

(Travel time varies)

3. *(Time varies)* Once you arrive at first location, hand out clipboard and data sheet as the students exit the bus. Once off the bus have them split into their three groups. One group will go with one SFEG volunteer or staff member to test dissolved oxygen and temperature, one group will go with another volunteer or staff member to test pH, and the last group will go with the remaining volunteer or staff member to test turbidity. These groups will not change throughout the day.
4. *(15- 20 minutes)* Volunteers and staff members follow the test kit directions and lead each group. (Directions for each kit are at the end as well as on laminated sheets with kits)
5. *(5-10 minutes)* Once chemistry tests are done at each site, have students flip to the back side of their data sheet and complete the Visual Habitat Assessment. This involves documenting habitat conditions such as substrate, water color, and presence/absence of pollutants, and aquatic plants and animals.
6. *(Time varies)* Clean test kits, pack up, and load kids back onto bus. Repeat tests and habitat assessment at each site until you arrive back at the school.
7. *(Time varies)* Once back in the classroom, have each group share their results with the class. Make sure all students write down results for all tests on data sheets. Ask the class if the quality of water is good for salmon or bad for salmon. Why?

Extra Notes:

For longer trips, one site will include time for lunch.

Evaluation:

Before the first unit of the JSS program, a pre-survey is handed out to each student. On this survey there are questions pertaining to this unit. There will be a post–survey handed out to the students at the end of the JSS program. This survey will have the same questions as the pre-survey. You can see if the students retained the information if the scores of each student increase from the time of the pre-survey to the post-survey.

Directions for Dissolved Oxygen and Temperature:

***When doing this test, wear safety glasses and latex gloves when possible. ***

To ensure all students participate, have a different student do each step of the test.

1. First put both thermometers in the body of water being tested to start the temperature measurement process.
2. Rinse the BOD bottle (round bottle with glass stopper) with the sample water before testing.
3. Fill the BOD bottle with sample water by allowing the sample water to overflow the bottle for 2-3 seconds. Avoid turbulence and bubbles if possible in the sample while filling.
4. Stopper the bottle carefully (underwater if possible) to avoid trapping air bubbles. If bubbles become trapped, discard the sample and repeat the filling process.
5. Remove the stopper and add one Dissolved Oxygen 1 Reagent Powder foil pouch and one Dissolved Oxygen 2 Reagent Powder foil pouch. Use the nail clippers to open each pouch if needed. Stopper the bottle carefully to avoid trapping air bubbles.
6. Invert the bottle several times until the powders are dissolved. Flocculent (floc) precipitate will form. Brownish-orange color indicates oxygen is present.
7. Wait for floc to settle to approximately half the bottle volume (below the white line on the bottle). It may take 4-5 minutes for floc to settle; while waiting, discuss chemical reactions students may have seen or done, such as Mentos candy in cola, or vinegar and baking soda.
8. Invert the bottle again to mix.
9. Wait for floc to settle again.
10. While waiting for floc to settle, grab thermometers to get temperature reading. Record findings.
11. Remove the stopper and add one Dissolved Oxygen 3 Reagent Powder Pillow. Use the clippers to open the plastic pillow.
12. Replace bottle stopper and invert the bottle several times. The reagent will dissolve, and the precipitate will look different from before. Instead of cloudy fuzz, it should turn into rust-colored flakes.
13. Fill small plastic tube completely full of sample.
14. Add the full plastic measuring tube of sample to the square bottle.
15. Add Sodium Thiosulfate Solution one drop at a time. Count the drops until the color changes from yellow to colorless. Swirl to mix after each drop.
16. The number of drops needed to turn the sample completely clear corresponds with the amount of dissolved oxygen in the water sample in parts per million (ppm).
17. Dump sample water into chemical bucket or the nearest sink; rinse all bottles and tubes. Put empty powder pillows into nearest trash receptacle.
18. Record all data onto data sheet.

⇒ Like us, salmon need oxygen to breathe, which they absorb from the water through their gills. Dissolved oxygen, the amount of oxygen in water, is measured in parts per million (ppm). To be healthy, salmon need a DO concentration of at least 6 ppm, though they will tolerate concentrations as low as 4 ppm.

Directions for pH:

1. Fill test tube with sample water to the 5 mL line
2. Add 10 drops of reagent
3. Cover with blue lid and mix for 10 seconds
4. Insert tube and compare. The number of the closest color match corresponds with the pH value
5. Dump water into chemical bucket or nearest sink; rinse test tube
6. Record all data collected on data sheet

⇒ pH, literally "parts Hydrogen", is a measure of the concentration of Hydrogen ions in a solution, which determines if a solution is basic (like bleach) or acidic (like lemon juice). Extremes in either direction on the logarithmic pH scale of 1-14 will kill aquatic life, as most life has a narrow pH range in which it can survive. Most life can tolerate a range of pH 6.5-8.2. A pH of 7.5 is ideal for salmon.

Extension:

Have the students test the pH of bleach, lemon juice, and/or vinegar and watch the colors change. It is fun to add the sample of an acid straight into the already tested water sample. The color will change immediately.

Directions for turbidity:

1. Fill one turbidity column (plastic tube) to the 50 mL line with sample water.
2. Fill second turbidity column to 50 mL line with distilled or tap water.
3. Place the two tubes side by side on a flat surface. Compare difference in clarity. If the black dot at the bottom of the tube is equally clear in both tubes, the turbidity of your sample water is zero.
4. If you cannot see the black dot at all in your creek water sample, dump both tubes so the water line is at 25 mL instead of 50mL and continue test as normal.

If there is a difference in the two tubes (it will usually be pretty subtle)…

4. Shake the Standard Turbidity Reagent (7520) vigorously. Add 0.5 mL to the distilled water tube. Stir both tubes with the stirring rod. Check visibility of black dot in both tubes. If the black dot is more visible in the sample water than in the distilled water, continue to add Standard Turbidity Reagent in 0.5 mL increments to the distilled water tube until both tubes are equally turbid (meaning the black dots in both tubes are equally visible). The number of times you had to add reagent to make the cloudiness of the sample and control equal corresponds to your JTU value.
5. Record all data collected on data sheet

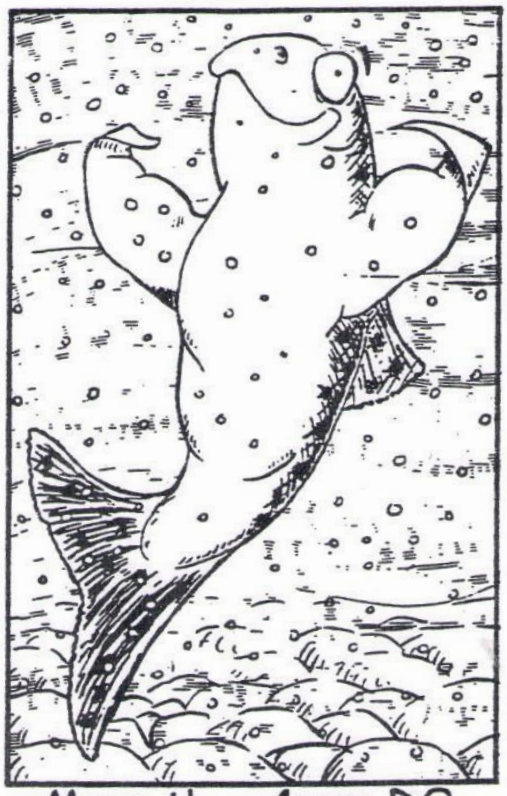
Next Generation Science Standards

Performance Expectations
MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. **MS-LS2-4.** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. **MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• Analyzing and Interpreting Data • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence • *Connections to Nature of Science* Scientific Knowledge is Based on Empirical Evidence	• LS2.A: Interdependent Relationships in Ecosystems • ESS3.C: Human Impacts on Earth Systems	• Cause and Effect • Stability and Change • *Connections to Engineering, Technology,* and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World

Other appendices on next pages...

DISSOLVED OXYGEN

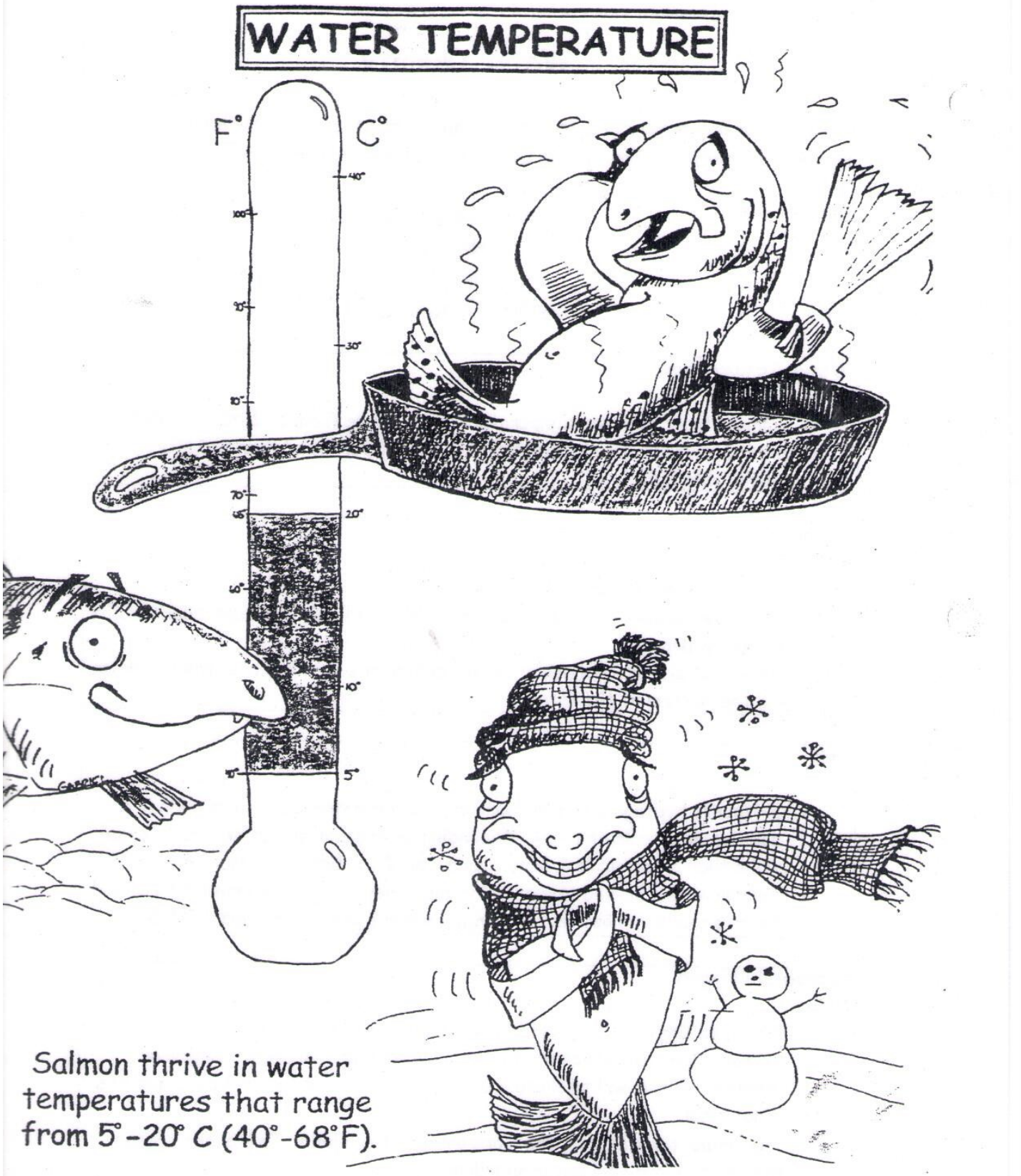


More than 4ppm DO

Dissolved oxygen (DO) is measured in parts per million (ppm).

Salmon need a DO concentration of at least 6 ppm in order to survive. Salmon will tolerate a DO concentration as low as 4 ppm, but this is not ideal.

Less than 4ppm DO


WATER TEMPERATURE
F°
C°
40°
30°
20°
10°
5°
Salmon thrive in water temperatures that range from 5°-20° C (40°-68°F).

FAHRENHEIT/CELSIUS CONVERSION CHART

Fahrenheit (F)	Celsius (C)
0	-17.8
10	-12.2
20	-6.7
32	0.0
40	4.4
50	10.0
60	15.6
70	21.1
80	26.7
85	29.4
90	32.2
100	37.8

How To Convert Temperatures	
Fahrenheit to Celsius	**Celsius to Fahrenheit**
1. Subtract 32 degrees Fahrenheit 2. Multiply by 5 3. Divide by 9	1. Multiply degrees Celsius by 9 2. Divide by 5 3. Add 32

STATE STANDARD FOR TEMPERATURE: For Class A freshwater, the temperature shall not exceed 18 degrees Celsius due to human activities.

Turbidity Facts

Turbidity is a measure of the amount of sediment suspended in water. Sediment can limit salmon survival during all stages of life.

Turbidity Scale

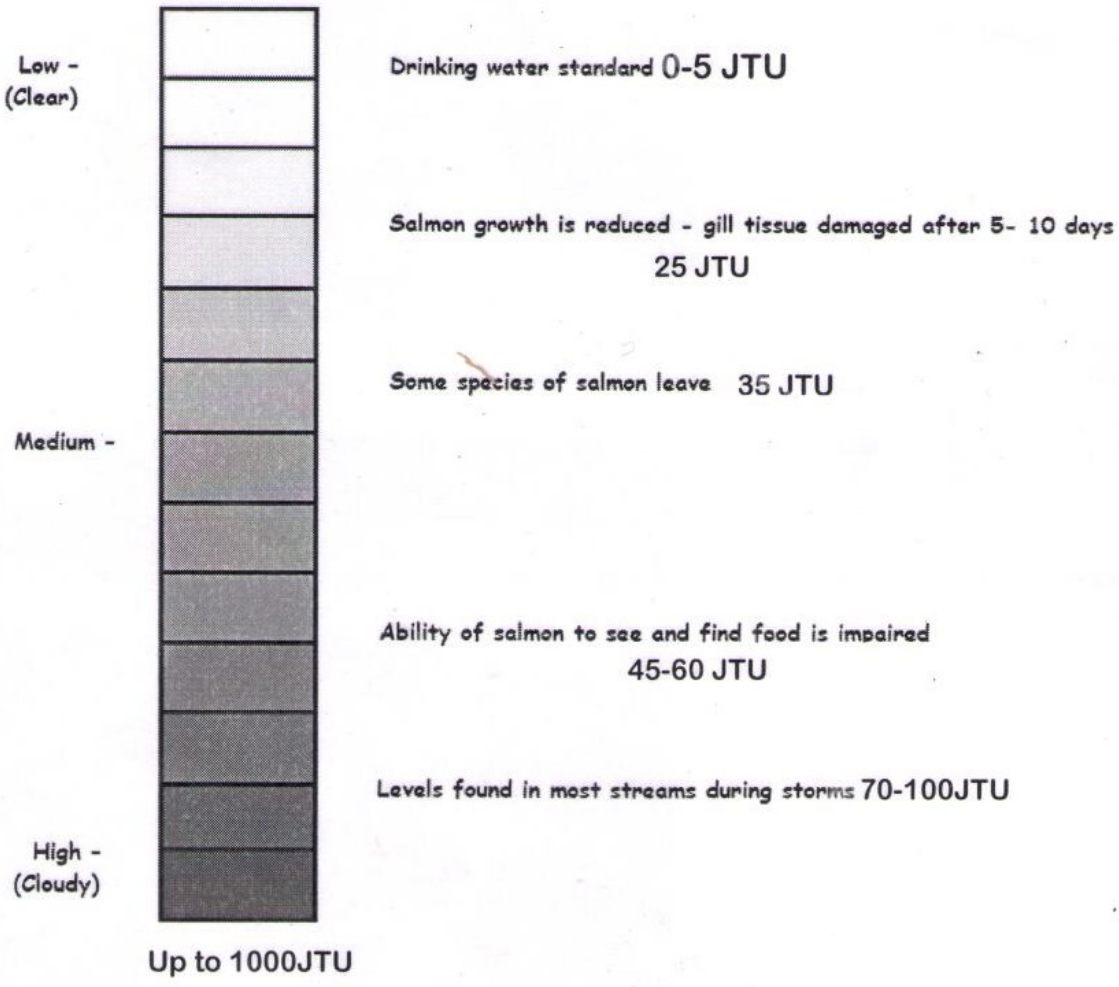
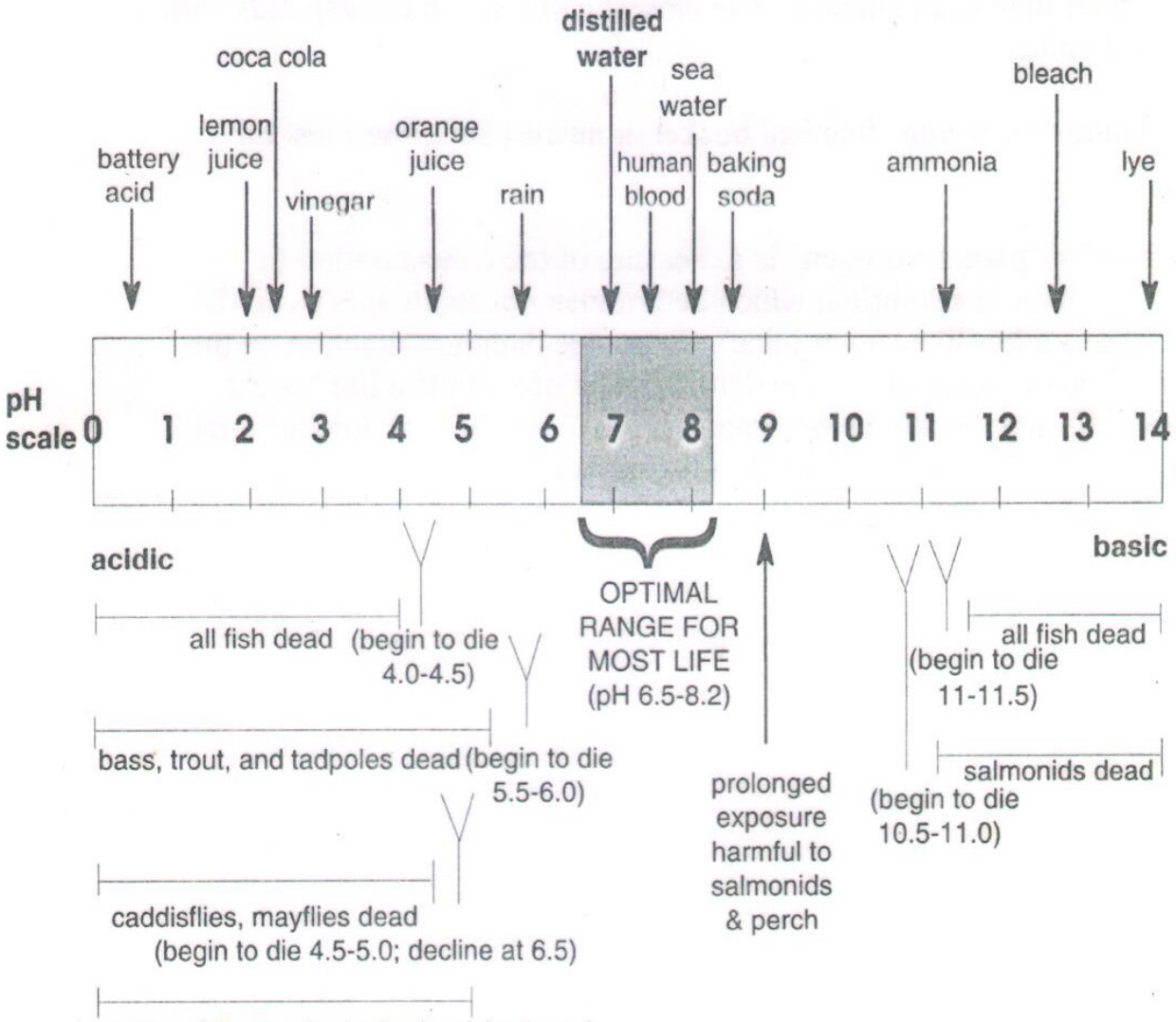


TABLE 9
pH OF COMMON SUBSTANCES AND LETHAL pH LIMITS FOR AQUATIC ORGANISMS



- salmonid eggs & alevin dead (reduced salmonid egg production 5.0-6.5)
- bottom dwelling bacteria (decomposers) begin to die (5.0-5.5) detritus accumulates, locking up essential nutrients
- sediments release metals into water in forms toxic to aquatic life
- snails & tadpoles begin to die (6.0-6.5)

Water Quality Data Sheet

Dissolved Oxygen (DO):

Like us, salmon need oxygen to breathe, which they absorb from the water through their **gills**. The amount of oxygen dissolved in the water is measured in parts per million (ppm). To be healthy, **salmon need a DO concentration of at least 6 ppm, though they will tolerate concentrations as low as 4 ppm.**

Following the directions on your water quality test kit, what is the dissolved oxygen level (in ppm)?

pH:

pH, or parts hydrogen, is a measure of the concentration of Hydrogen ions in a solution, which determines if a solution is basic (like bleach) or acidic (like lemon juice). Too low or too high a pH can kill aquatic animals; most life can tolerate a range of pH 6.5-8.2. **A pH of 7.5 is ideal for salmon.**

Following the directions on your water quality test kit, what is the pH ?

Turbidity:

Turbidity is a measure of how much sediment is suspended in the water. Too much sediment can clog gills and smother eggs of salmon and other aquatic life. **What is the turbidity of your sampling site)?**

Water Temperature:

Salmon thrive in water temperatures from 5-20 degrees Celsius (40-68 degrees Fahrenheit). Temperatures outside this range are dangerous. **What is the temperature of your sampling site?**

Site	Temp	DO (ppm)	pH	Turbidity (JTU)

Habitat Assessment

Gravel: Salmon need gravel for spawning. By laying their eggs in gravel their young will be protected from predators and being carried down stream.

What is the nature of the stream bed?

Site	Gravel size (circle the size that describes the gravel at each site)
	silt/mud size) small (pea-sized) medium (golf ball size) large gravel (fist
	silt/mud size) small (pea-sized) medium (golf ball size) large gravel (fist
	silt/mud size) small (pea-sized) medium (golf ball size) large gravel (fist

Vegetation: Streamside plants are crucial for salmon. Trees and bushes next to streams provide shade to keep the water cool and places for both adults and juvenile salmon to hide, while their roots hold the bank together.

What is the vegetation like at the side of the stream at each site?

Site	Vegetation Observations (Are there any plants? Can you name any?)

Pollution: Do you see any signs of pollution at your site (for example, garbage, film on the water, etc.)? What is the color of the water? Is it clear? Do you see any aquatic life?

Site	Pollution? Water color? Aquatic life?

Conclusion: Looking at all the water quality factors, does your site have good enough water quality and habitat to support salmon? Why/Why not?

What is the Salmon Lifecycle?

Grade Level: 6-8

Subject areas: Science, Environmental Education

Duration: 1 hour

Group size: 20-30 kids

Setting: Classroom

Key Terms: Anadromous, alevin, fry, smolt and redd

Appendices: JSS PowerPoint and JSS journal

Objective:

By the end of this unit, students should be able to explain the salmon lifecycle. They should be able to list elements necessary for a successful lifecycle and name all life stages of a salmon.

Method:

Through a presentation via PowerPoint and a hands-on activity the students will get a multimedia lesson great for all learning types. They will also receive either a salmon lifecycle bracelet or keychain as a take home piece.

Materials:

- PowerPoint presentation
- JSS journal
- Pictures of all five species of Pacific salmon
- Keychain rings
- Baggie of salmon lifecycle bracelet/Keychain materials

  -stretchy string about 9 inches long

  -2 pony beads each of the following colors; black, orange, red, green, clear and light blue

  -1 pony bead each of the following colors, dark blue and pink

Background:

Knowledge of the salmon lifecycle is necessary for this lesson. Salmon start as eggs that the female lays in a gravel nest called a redd. **Alevin** emerge from the surviving eggs. Alevin are very small fish with an attached yolk sac. Once they consume all of their yolk sac, they become **fry**. Then they migrate to the estuary and become **smolts**. Once they reach the ocean they grow to their adult stage and remain at sea for 2-5 years, species dependent. They return to their original stream where they were "born". Then they change to their to their spawning colors as they journey to their home stream. The female builds her **redd**, or nest, and lays her eggs. The male hovers next to her and sprays his milt over the eggs, fertilizing them.

There are many factors that are necessary for a successful salmon lifecycle. First, the water that they live in must be made up of the 4 Cs, (clean, cold, clear and consistent). Second, the stream must have a healthy riparian area. These trees, shrubs, and other plants provide necessary shade, food, and shelter for the salmon. Third, there must be a healthy food source for the salmon and their young to eat. Fourth and last, there must be appropriate gravel for salmon to make their redds.

Some other helpful things to know for this lesson are the five species of Pacific salmon: Chinook, chum, coho, sockeye, and pink. Salmon are **anadromous** which means they start life in fresh water, mature in salt water and then reproduce back in fresh water. Salmon also need good rearing habitat, a habitat for the young salmon until they are fully grown, usually an estuary. There are also many predators to the salmon in the river (eagles, bears, other birds, humans) and the ocean (whales, seals, other fish, humans).

Preparation:

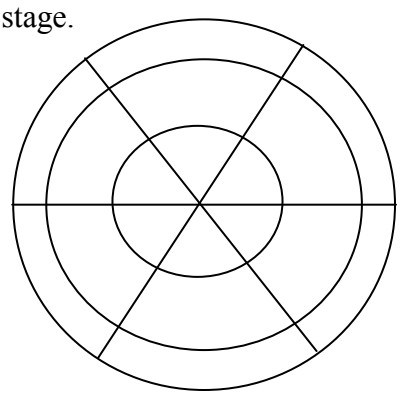
1. Before the lesson, prepare the salmon lifecycle bracelet/ keychain kits. Cut the stretchy string into 9-inch lengths.

1.Continued… Tie a black bead tightly onto the stretchy string at one end. Make sure there is about 1.5” on one side of the bead and then the rest of the string on the other end of the bead. Place the string with bead in a Ziploc bag. Along with the string and the attached bead, place two beads of each of the following colors, orange, red, green, clear and light blue. Then place a single bead of pink, dark blue and one more black bead in the bag. Now close the bag and repeat as many times as needed to have one prepared bag per student.

2. Before the lesson, prepare PowerPoint and make sure it is in working order. The day of presentation, make sure PowerPoint works on classroom computer.

3. Before the start of lesson, prepare all materials, make sure you have enough baggies, keychain rings, and paper handouts.

4. Draw the diagram below (it is in their journal) on the board and label it like it is in the journal, with habitat, needs, and lifecycle stage.



Procedure:

1. *(0-5 minutes)* Start by welcoming the class back to Junior Stream Stewards and make sure that all the students have their JSS journal. Review the previous lesson, in this case the last lesson was the water quality/watershed tour. What do the students remember from the last lesson?

2. *(5-10 minutes)* Proceed onto the first slide. Explain to the students that salmon are anadromous. Define anadromous. Have the students write the definition in their journals, below the circular diagram.

3. *(10-15 minutes)* Continue to the next slide. Tell them that there are four things relating to water that start with the letter C that salmon need to survive (cold, clear, clean, consistent). They are called the Four Cs. Can they guess them? As the students guess them, have them write the words down in the chart/table in their journals. Ask the students to explain why each of the four Cs are important for salmon and have them write down the importance in their journals (cold water holds more oxygen, clear water allows fish to see and breathe, clean water has no pollution, and consistent allows water access at all times). Write them on the board as well, so the students can reference.

4. *(15-20 minutes)* It is now time to learn the lifecycle. Ask the students what they think the first life stage is. EGGS! Ask them what habitat are the eggs found in, salt or fresh water and fill it in the diagram. What do the eggs need for survival (4 Cs, shelter in the form of gravel, oxygen, etc.). Continue on to the next life stage, alevin. Ask what habitat do they live in and what do they need? They have the same habitat and same needs as eggs. Explain that they don’t need food because they have their yolk sac still.

5. *(20-25 minutes)* Continue with the life stages. Next is the fry stage. Ask what habitat do fry live in and what do they need for this life stage? Write fresh water habitat and they need the 4 Cs, shelter in the form of large woody debris, oxygen, FOOD, i.e. macroinvertebrates). After fry stage is smolt stage. This time they don’t live in fresh or salt water habitat. Ask the students if they know ESTUARY. The smolt need the same things as fry but their shelter is the eel grass, and they are now in brackish water (part fresh, part salt).

6.*(25-30 minutes)* Next is ocean adults. Have the students write that ocean adults live in salt water. They need the 4 Cs, shelter in the form of each other/schooling fish, oxygen, and food.

6 *Continued...* Their flesh is pink because of the food they eat in this life stage such as shrimp and krill. Also discuss the predators that salmon have in the ocean like orcas and humans.

7. *(30-35 minutes)* Last life stage, spawning adults. When the fish are ready, they return back to the stream where they hatched. The fish don't eat on their journey back to their home stream, instead they spend all of their energy on reproduction and the formation of their eggs or milt. If you refer back to the salmon dissection, there wasn't any food in their stomach. Discuss the predators on salmon in the rivers, because they are very different than in the ocean. They include eagles, bears, people, etc.

8. *(35-38 minutes)* Conclude the discussion and prepare to do the salmon lifecycle bracelets. Have someone hand out one life cycle kit (baggie) to each student.

Salmon Lifecycle Bracelets

9. *(38– 40 minutes)* Ask the students to open their baggies but don't pour the contents, they WILL lose the beads. Also tell them not to swing their strings around with beads on it, they will fly. Ask them what they think the first black bead represents. Switch to the first slide of the activity. It is gravel. Confirm with the students that salmon need the right type of gravel to make a nest. The gravel size changes depending on the species of salmon.

10. *(40– 42 minutes)* Ask the students what they think comes next. Once they guess tell them it is red. Pull up red slide. What do they think that the red bead represents? It represents a redd of course, the nest that the salmon make in the gravel. The size of the redd depends on the gravel size and the species of salmon. Explain how a female salmon builds a redd (if you haven't showed them already).

11. *(42– 44 minutes)* The next slide color is orange. What do the students think this represents? Orange represents eggs. The eggs are orange in color and are deposited in the gravel that makes the redd.

12. *(44– 46 minutes)* Next is green, which stands for...? Trees and the riparian area. Trees provide shade which keeps the water cool and provides cover from predators. The trees and plants also provide leaf litter for bugs to eat, the bugs that the salmon feed on. The big branches that come off the trees also provides large woody debris (LWD) in which the salmon can hide and rest.

13. *(46– 48 minutes)* Next is the clear bead. What does it represent? Cool, clean, clear and consistent water that the salmon need to live. The water needs to be clear and clean because the dirt will get stuck in their gills and impede respiration. The water must also be cold so there is more dissolved oxygen that the salmon need to breathe.

14. *(48– 50 minutes)* Next is the light blue bead and slide: Estuary habitat. Does anyone in the class know what an estuary is? Estuaries provide rearing habitat where the salmon can transition from fresh water to salt water or visa versa. When estuaries are healthy they provide lots of food and shelter for salmon too.

15. (*50– 52 minutes*) Next is dark blue, only one in the bag. It is the ocean stage. In this phase of their lives they spend a lot of time eating, but they are also food for many predators.

16. *(52– 54 minutes)* Next is the single pink bead, representing the food that the salmon get in the ocean. It is their main food source for their ocean phase. They generally eat shrimp, krill, and small fish. This also gives salmon meat its pink color, like flamingos!

17. *(54– 56 minutes)* Now ask the class if they know what happens now. What happens to the salmon when they are at the ocean phase of their life? They go back. So the beads and the PowerPoint slides now go in reverse order because that is what happens in the lifecycle. Reverse order until the green bead at least. The salmon cannot have eggs or redds without gravel, so black is next. Then they can't have eggs without their redd, so the red is next. Followed lastly by the orange bead. That's it.

18. *(56– 60 minutes)* Now you, the teacher, or any adult helpers can help the students tie their bracelets or keychains so they don't fall apart. Also this is the time to clean up and finish activity.

Extension:

If time allows, go into more detail about the five species of Pacific salmon, including ways to remember the names. There is so much information out there!

Evaluation:

Before the first unit of the JSS program, a pre-survey is handed out to each student. On this survey there are questions retaining to this unit. There will be a post–survey handed out to the students at the end of the JSS program. This survey will have the same questions as the pre-survey. You can see if the students retained the information if the scores of each student increase from the time of the pre-survey to the post-survey.

Next Generation Science Standards

Performance Expectations
MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. **MS-LS1-5.** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. **MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• Obtaining, Evaluating, and Communicating Information • Asking Questions and Defining Problems	• LS4.B: Natural Selection • ESS3.C: Human Impacts on Earth Systems	• Cause and Effect • Stability and Change • *Connections to Engineering, Technology,* and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World

What is a Healthy Riparian Zone?

Grade Level: 6-8

Subject areas: Science, Environmental Education

Duration: 1 hour

Group size: 20-30 kids

Setting: Classroom

Key Terms: Riparian area/ forest/zone, conifer, deciduous, shrub, invasive, native

Appendices: Attached PowerPoint presentation , plant cheat sheets, and JSS journal

Objectives:

Students will be able to explain what a riparian forest is, why they are important to salmon, and how these forests become and remain healthy.

Method:

Through a PowerPoint presentation and activity the students will gain a greater understanding of riparian zones.

Materials:

- PowerPoint presentation
- Markers, paper

Background:

A **riparian zone** is the area of land that borders a body of water. A forested area that is adjacent to a body of water is a riparian forest.

These forested areas are extremely important to the health of these bodies of water. For streams and salmon specifically, trees and shrubs shade the stream, keeping the water cool; the roots stabilize the soil, reducing erosion and keeping the water clearer; the roots filter pollutants and other chemicals to keep the stream clean; the leaves fall off of the plants and provide food for macroinvertebrates, and last but not least these trees and shrubs eventually die or fall creating large woody debris in the water that provides cover for fish.

Dense, diverse forests make healthy riparian zones. Dense forests can shade out nonnative plants and prevent invasive species takeover, and diversity allows many native plants and animals to thrive there. These **native** plants are plants that are indigenous to our forests, provide habitat, and create balance in the riparian zone.

There are two types of trees that live in the riparian zone, evergreen and deciduous. **Evergreens** keep their leaves throughout the year. **Deciduous** trees lose their leaves during the fall and winter months and grow new ones in spring and summer. Some native evergreen trees that you can see in our riparian zones are Douglas fir, Sitka spruce, and Western redcedar. Some examples of deciduous are big leaf maple and red alder. There are also many native shrubs in riparian zones. **Shrubs** are defined as woody plants somewhat smaller than trees. Some native shrubs are ninebark, salmonberry, snowberry, and spirea.

Along with our native plants are invasive plants. An **invasive** plant is a plant that is originally from someplace else, was brought to our forest, and then TAKES OVER the forest, making it difficult for native plants to grow. Some examples of invasives in our area are Himalayan blackberry, English ivy, and Japanese knotweed.

What can we do to help keep our riparian zones healthy? We can plant native trees and shrubs creating dense and diverse ecosystems, remove invasive species, and build barriers to keep cattle our of our streams and..?

Procedure:

Presentation

1. *(0– 3 minutes)* Review last unit. Ask the class to go over the salmon life cycle, define anadromous, explain the 4 Cs, go over some things salmon need to live, and ask any other questions relating to unit 4 Salmon Lifecycle.

2. *(3– 6 minutes)* Start with the first slide in the PowerPoint. Ask the class to define a Riparian Forest. Have the students take a few guesses and lead them in the right direction. Then define. Ask them what bodies of water they have been to and relate what they say by telling them all of those bodies of water have riparian zones. Make sure they write the definition of a riparian forest in their journals.

3. *(6– 10 minutes)* Ask the class, "Why are we talking about plants? How are these riparian zones important? What do they have to do with salmon?"

4. *(10– 15 minutes)* Next PowerPoint slide. Click the slide one by one and discuss the four main ways native plants help salmon. Make sure they write down two of the four.

   A. Trees provide shade which cools the water and creates cover from predators.

   B. Logs and branches fall into the water creating shelter and slow moving water for fish to rest.

   C. Many macroinvertebrates eat fallen leaves; macroinvertebrates are food for salmon.

   D. Plant roots stabilize the soil and filter pollutants from the water.

6. *(15– 20 minutes)* Continue to the next slide. Explain to the class that a healthy riparian area doesn't just help salmon, it helps all organisms that live and use the riparian zone. Explain that healthy riparian forests are dense and diverse. Ideas on other species?

7. *(20– 27 minutes)* Go through the next five slides one by one. Tell the class that you are all going to identify a few plants in a riparian forest. Explain the difference between deciduous and conifer trees and have them write one example of each in their journal. Also explain what a shrub is and have them write an example.

8. *(27– 32 minutes)* Continue to the next slide. Now let's talk about invasive species. Ask the class if anyone knows what an invasive species is. If not explain to them and give them some examples which are listed in the few slides. Again make sure they write the definition down.

9. *(32– 35 minutes)* Now it is time to go over some things we all can do to keep our riparian forests healthy. Have the class try to name a few things they can do and add on to what they say. They must write down two ways in their journals.

10. *(35-38 minutes)* Now, discuss with the class what they are going to do next month with SFEG. They will be doing one of the things discussed to help keep and make the forests healthy. Go over proper attire and what to bring, and what to expect on the field trip. We go rain or shine!!

Activity

11. *(38-42 minutes)* Now it is time for the activity. The students can be in groups or they can be solo, its up to them and the teacher.

12. *(42– 45 minutes)* Hand out the directions to each group. They will now become planners. A landowner has asked them to plan an appropriate riparian forest on their property. They are given $500 to plant the assorted trees and shrubs in an appropriate way according to the rules. They are also given a cheat sheet to the types of plants they can use and what levels of sun and moisture these plants prefer.

13. *(45-55 minutes)* For the rest of the time have the students plant their riparian forest.

Extension:

If you finish early, have the students share their planting plan with the class. Why did they choose those trees and shrubs? Why did they choose to place the plants in those areas?

Evaluation:

Before the first unit of the JSS program, a pre-survey is handed out to each student. On this survey there are questions retaining to this unit. There will be a post–survey handed out to the students at the end of the JSS program. This survey will have the same questions as the pre-survey. You can see if the students retained the information if the scores of each student increase from the time of the pre-survey to the post-survey.

Next Generation Science Standards

Performance Expectations
MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. **MS-LS2-1.** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. **MS-LS2-5.** Evaluate competing design solutions for maintaining biodiversity and ecosystem services. **MS-ESS3-3.** Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• Analyzing and Interpreting Data • Engaging in Argument from Evidence • Asking Questions and Defining Problems • Constructing Explanations and Designing Solutions	• LS1.B: Growth and Development of Organisms • LS2.A: Interdependent Relationships in Ecosystems • LS2.C: Ecosystem Dynamics, Functioning, and Resilience • LS4.D: Biodiversity and Humans • ETS1.B: Developing Possible Solutions • ESS3.C: Human Impacts on Earth Systems	• Cause and Effect • Stability and Change • *Connections to Engineering, Technology,* and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World • *Connections to Nature of Science,* Science Addresses Questions About the Natural and Material World

How did you Improve your Watershed?

Grade Level: 6-8

Subject areas: Science, Environmental Education

Duration: 2+ Hours

Group size: 20-30 kids

Setting: In the Field

Key Terms: Stewardship

Appendices: None

Objectives:

By the end of the fieldtrip the students should give examples of land stewardship and feel like they have successfully accomplished one form of stewardship.

Method:

Students will go to a riparian area and help restore it in some way depending on what is needed at available sites; usually planting or invasive species removal.

Materials:

- Tools (Shovels, hand pruners, loppers, dibble bars)
- Gloves (one pair per student)
- Boots (one pair per student)
- Porta Potty, if needed

Background:

The background may vary depending on the site.

Some safety that always applies:

- Shovels– never place shovel with blade up, if someone steps on the blade the handle could fly up and hit the person. Never drag the shovel or push the shovel into hard ground for storage, this dulls the blade. Never carry a shovel with the blade over your shoulder; you may accidentally hit someone in the face.
- Hand pruners and loppers– Always watch what you are cutting, so you don't cut something accidentally. When walking, never running, they need to be in the locked position at your side. They should never be raised above your shoulders.
- Dibble bars– Walk with these, never run. They are not pogo sticks, when in use, one foot must remain on the ground at all times. Always be aware of where you set these, they are heavy and could break toes if dropped.

Preparation:

1. Before the day of the fieldtrip go to the site and examine. See what exactly the class will be doing and where they will be doing it.
2. Call volunteers to help with the project. Make sure you have **at least 2 other volunteers.**

Procedure:

1. *(Time varies)* Arrive at stewardship site early. Meet volunteers and go over the agenda for the day.
2. *(Time varies)* Prepare the site if needed. (i.e. place plants, get out tools, organize gloves, boots, etc.)
3. *(Time varies)* When bus arrives to site, go onto the bus and welcome the students to the site and review what they did last time you saw them during the riparian unit. Connect what they are doing at the site with the riparian unit concepts, whether that be planting native plants or removing invasive species. Then unload the students from the bus.
4. *(Time varies)* Gather the students in a circle and introduce the students to the site and to any new volunteers. Explain what you all are going to do and how that will positively affect the riparian zone.
5. *(Time varies)* Divide students into groups (the number of groups will vary depending on how many volunteers and staff you have to lead them.

5. cont'd ...You will want one volunteer or staff member per group). Have the students meet their group leader where they can go over safety in small groups. Safety will vary depending on site.
6. *(Time varies)* Once safety has been discussed in the small groups, each group can then grab the supplies they need (gloves, tools, etc.). The small groups will then work in a designated area until lunch or about 30 minutes before their time is up and they must return to their school.
7. *(Either after lunch or 30 minutes before they leave site)* Gather students in a circle for a brief reflection activity. One we like is Rock/Stick/Leaf: gather a rock, stick, and leaf; (or a rock, stick and lichen). Tell the students that you will pass these three things around the circle, talking-stick style . One by one each student must pick one of the three things and either tell the class what rocked about the fieldtrip, what will stick with them, what will they "*leaf*" behind or what did that they "*lichen*". You start the circle and pass the three things to your right. Make sure that everyone gets a chance to say something appropriate.

Extension:

If you get done early you can play hooks and ladders or another educational fun activity.

Evaluation:

Before the first unit of the JSS program, a pre-survey is handed out to each student. On this survey there are questions retaining to this unit. There will be a post–survey handed out to the students at the end of the JSS program. This survey will have the same questions as the pre-survey. You can see if the students retained the information if the scores of each student increase from the time of the pre-survey to the post-survey.

Next Generation Science Standards

Performance Expectations
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• Constructing Explanations and Designing Solutions	• ESS3.C: Human Impacts on Earth Systems	• Cause and Effect • *Connections to Engineering, Technology,* and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World

How are the 5 Pacific Salmon Species Different?

Grade Level: 6-8

Subject areas: Science, Environmental Education

Duration: 1 hour +/-

Group size: 20-30 kids

Setting: Classroom

Key Terms: Chinook/King, coho/silver, chum/dog, sockeye/red, pink/humpy

Appendices: Salmon board game and rules

Objectives:

By the end of the unit students will be able to name the five species of Pacific salmon. They will be able to tell you how these species are similar and different and be able to name human and natural factors that positively and/or negatively effect salmon.

Method:

Students will play a board game where they become one of the five species of salmon. They must try to spawn even though they have many obstacles.

Materials:

- Salmon Game board
- Salmon Game pieces and cards
- Dice
- Rules

Background:

Before you lead and play the game it is good to know the five species of Pacific Salmon. Chinook/King, coho/silver, chum/dog, sockeye/red, and pink/humpy.

You will also need to know the rules, which are as follows:

- Goal of the game: Migrate from the Salish Sea (START) to the spawning grounds in one of the tributaries of the Skagit or Samish rivers. Only certain species of salmon can spawn in certain tributaries, just like in the real Skagit and Samish Rivers. The winner is the first player to successfully spawn.
- Colors on the bottom of the playing piece correspond to the colors on the tributaries. They want to make it to one of the tributaries whose spawning grounds match the color of their game piece.
- Roll both dice, move your game piece the amount on the dice, then draw a Fishy Scenario card. Whatever is stated on the card now affects some or all of the players.
- Pink salmon only roll every other turn. This may seem like a disadvantage, but they are NOT affected by Fishy Scenario cards during their unrolled turn.
- If the card says watershed (it is underlined), it refers to both the main stem of the river (Skagit or Samish) and all the tributaries on that river.
- If you are not in a tributary (Friday Creek, Day Creek, Sauk River, or Cascade River) you are in the main stem of either the Skagit or Samish River.
- If you draw a card that cuts your roll in half and you roll an odd number, round up (example if you roll a seven, move 4 spaces).
- If you draw a card that says to place a dam or culvert, place a dam or culvert piece on that space.
- If the card tells you to roll 11 or 12 times, only roll 1 di.
- There is a card with a blank on it (____). This will be an estimated space where their school would be on the board. Have them try to guess why the space is that specific space.
- If you get cut off by a dam, or draw a card that says you must find a new place to spawn, you must retrace your way back to the Salish Sea and go back up the other river or a different tributary.

Preparation:

1. Make sure you have all the pieces of the game. There should be enough games for each class (5 students per game).

Procedure:

1. *(0- 5 minutes)* Review stewardship fieldtrip.
2. *(5– 7 minutes)* List the 5 species of Pacific salmon and explain that this lesson goes into how humans impact them individually. However, they are going to learn this in a unique way. They are going to play a board game.
3. *(7– 15 minutes)* Let the students know that before we start the game, we should go over the 5 species. Go over the 5 finger remembering trick (Thumb-chum/dog- they rhyme, pointer finger-Sockeye/red– sock yourself in the eye your eye turns red, Middle finger– Chinook/King– Largest salmon is the largest finger, Ring finger– Silver/coho– You put a silver ring on your ring finger, Pinkie finger– Pink/humpy– They sound the same).
4. *(15– 18 minutes)* Now we will play the game. Tell the students that they can pick their own groups but they must be strategic. If they are not on task their groups will be rearranged. Have the students get into groups of 5, (fewer is ok, but not more). You want as many groups of 5 as possible.
5. *(18– 25 Minutes)* Explain the rules of the game that are listed. Go over every rule with the class as a whole, one by one.
6. *(25– 50 minutes)* Now let the class play the game. Observe how the game is going, and answer questions as they come up.
7. *(50– 60 minutes)* Now gather the students back together as a whole group. Ask them what they thought of the game. Ask them some questions. What human impacts are there on salmon? What natural impacts are there on salmon? What are some differences you noticed between the species? Do they spawn in the same places or different places? Are they the same? How are they different?

Extension:

If you get done early you can play the game for longer by having the students switch the species of fish they are after someone wins/spawns.

Evaluation:

Before the first unit of the JSS program, a pre-survey is handed out to each student. On this survey there are questions retaining to this unit. There will be a post –survey handed out to the students at the end of the JSS program. This survey will have the same questions as the pre-survey. You can see if the students retained the information if the scores of each student increase from the time of the pre-survey to the post-survey.

Next Generation Science Standards

Performance Expectations
MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. **MS-LS4-5.** Gather and synthesize information about the technologies that have changed the way humans influence the inheritance of desired traits in organisms. **MS-ESS3-2.** Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects. **MS-ESS3-4.** Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• Constructing Explanations and Designing Solutions • Obtaining, Evaluating, and Communicating Information • Asking Questions and Defining Problems • Engaging in Argument from Evidence	• LS4.B: Natural Selection • LS4.C: Adaptation • ESS3.C: Human Impacts on Earth Systems	• Patterns • Cause and Effect • Stability and Change • *Connections to Engineering, Technology,* and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World • *Connections to Nature of Science,* Science Addresses Questions About the Natural and Material World

What do Macroinvertebrates Tell us about our Streams?

Grade Level: 6-8

Subject areas: Science, Environmental Education

Duration: 1 hour

Group size: 20-30 kids

Setting: Classroom

Key Terms: Macroinvertebrate, dominance, and indicator species

Appendices: Attached PowerPoint presentation , macro posters, and JSS journal

Objectives:

Students will be able to define and identify macroinvertebrates and they will be able to categorize stream heath based on the macroinvertebrates they see.

Method:

Students will watch a short PowerPoint and then identify live macroinvertebrates in their classroom.

Materials:

- PowerPoint presentation
- Tupperware/tubs
- Bucket (s)
- Macroinvertebrate posters
- Macroinvertebrates

Background:

A macroinvertebrate is an organism that is large enough to be seen with a naked eye and has no backbone. In streams these are mostly insects that have an exoskeleton and go through a lifecycle called metamorphosis.

There are two types of metamorphosis, complete and incomplete. Complete metamorphosis has four life stages (egg, larva, pupa, and adult) while incomplete has three stages (egg, nymph, and adult).

During the fry stage of a salmon's lifecycle they eat macroinvertebrates. Macroinvertebrates eat leaf litter provided by the nearby vegetation, algae on the rocks, or each other.

There are many types of macroinvertebrates in and near our streams including mayflies, stoneflies, caddisflies, dobsonflies, planarians, damselflies, aquatic worms, etc.

Different types of macros tell us different things about the quality of water in our streams. There are three groups of macroinvertebrates. Group one contains macros that cannot tolerate pollution. If you find macros in this group in your stream that means your stream has good water quality. Group two contains macros that can tolerate <u>some</u> water pollution. Macros in this group indicate moderate stream water quality. Group three macros are much more tolerant of poor water quality. Just because you have macros from group three doesn't mean that the quality is poor unless there is **a predominance** of group three. The **abundance** of the macros from each groups give you the quality of stream water. Macros are **indicator species** that directly tell us the health of a stream.

Preparation:

1. At least an hour before the class starts, go to a stream near the school and collect macroinvertebrates.
2. Go to the streambank, with rain boots on, lift rocks and look on the bottom of the rocks. You will see the macros moving. You can also lift a rock and swish it around in the bucket of water. This will help you loosen the macros grip on the rocks. Put all the collected macros in a bucket and take to the class.
3. Once you get to the classroom, put a few macroinvertebrates in tubs. Make sure that each tub has a diversity of macroinvertebrates so the students can see the many types of macros we have here. There should be about 6-8 tubs of macros total.
4. Last, set up the PowerPoint.

Procedure:

1. *(0– 5 minutes)* Review the last unit and the salmon game. Review the 5 Pacific salmon species/ hand remembering trick. Also ask them to name one human and/or natural impact on salmon.

2. *(5– 10 minutes)* Intro: Ask them to try to define what a macroinvertebrate is. Pull the word apart. What does macro– mean? What about invertebrate? Macro – means "large" it sounds like micro– but micro means "small". Tell them we aren't looking at huge bugs the size of elephants right?! Let them know size is relative. Macroinvertebrates are just large enough to be seen with your naked eye. A vertebrate is an organism with a backbone, so an invertebrate is an organism without a backbone. Have them come up with some examples of vertebrates and invertebrates. Have them write in their JSS journals that a macroinvertebrate is an organism with no backbone that is large enough to be seen with the naked eye. Ask them, "why are these macros important? Why are we, fish people, teaching about bugs?" Tell them its because these bugs are the main food source for the salmon before they migrate to salt water.

3. *(10– 13 minutes)* Move onto the next slide. Let them know that most of the macros that we are going to look at today go through a process known as metamorphosis. Ask them to give an example of an organism that goes through this process (i.e. caterpillar). Pull out the metamorphosis poster and explain to the class the two types of metamorphosis: complete and incomplete.

4. *(13– 22 minutes)* Now let's go over some of the macros we will see. The next three slides give examples. Go over mayfly, stonefly, and caddisfly with the class and explain the differences between them. Stoneflies have gills that look like little hairs, emerging from the joints in the body segments, and where legs join the body. Sometimes we see them appear to be doing push-ups, whereas mayflies have their gills on their abdomens, and resemble feathers along their sides. Most caddisfly larvae we catch have casings made out of silk and materials from the stream (pebbles, fir needles, etc.). Some artists use caddisflies to create gold and gem jewelry. Make sure they write two macros in their journals. Can students think of more?

5. *(22– 27 minutes)* Move to the next slide. Have the class look at the picture provided. Does this stream look like good salmon habitat or bad salmon habitat? Why?. Explain it is good habitat because it has the 4Cs, gravel, and lots of vegetation. It is important to note that because it is good habitat for salmon, it is good habitat for macroinvertebrates too. It is a predator and prey relationship, and they need the same things to survive.

6. *(27– 30 minutes)* Explain what an indicator species is. It is a species whose presence or absence tells us about the health of the ecosystem. Macros are a biological indicator of the health of our streams. They are grouped into three groups. Pull out the macroinvertebrate index poster (looks similar to the one in their journals). Go over the three groups with the class.

7. *(30– 50 minutes)* Explain what the students need to do in the next 20 minutes. Have the students draw and identify two macroinvertebrates and circle all the ones they see on their macroinvertebrate index. Pass out the tubs with macros, one tub to each group of students (the students are usually grouped already). Give them time to observe.

8. *(50– 60 minutes)* Collect the tubs of macroinvertebrates and set them aside. Ask the class who saw a dominance of macros from group 3? Group 2? How about group 1? Ask them if the stream is healthy based on the macros they saw. The answer will almost always be good water quality.

Extension:

If you get done earlier than expected have the students share their drawings and give them more time to look at the macros.

Evaluation:

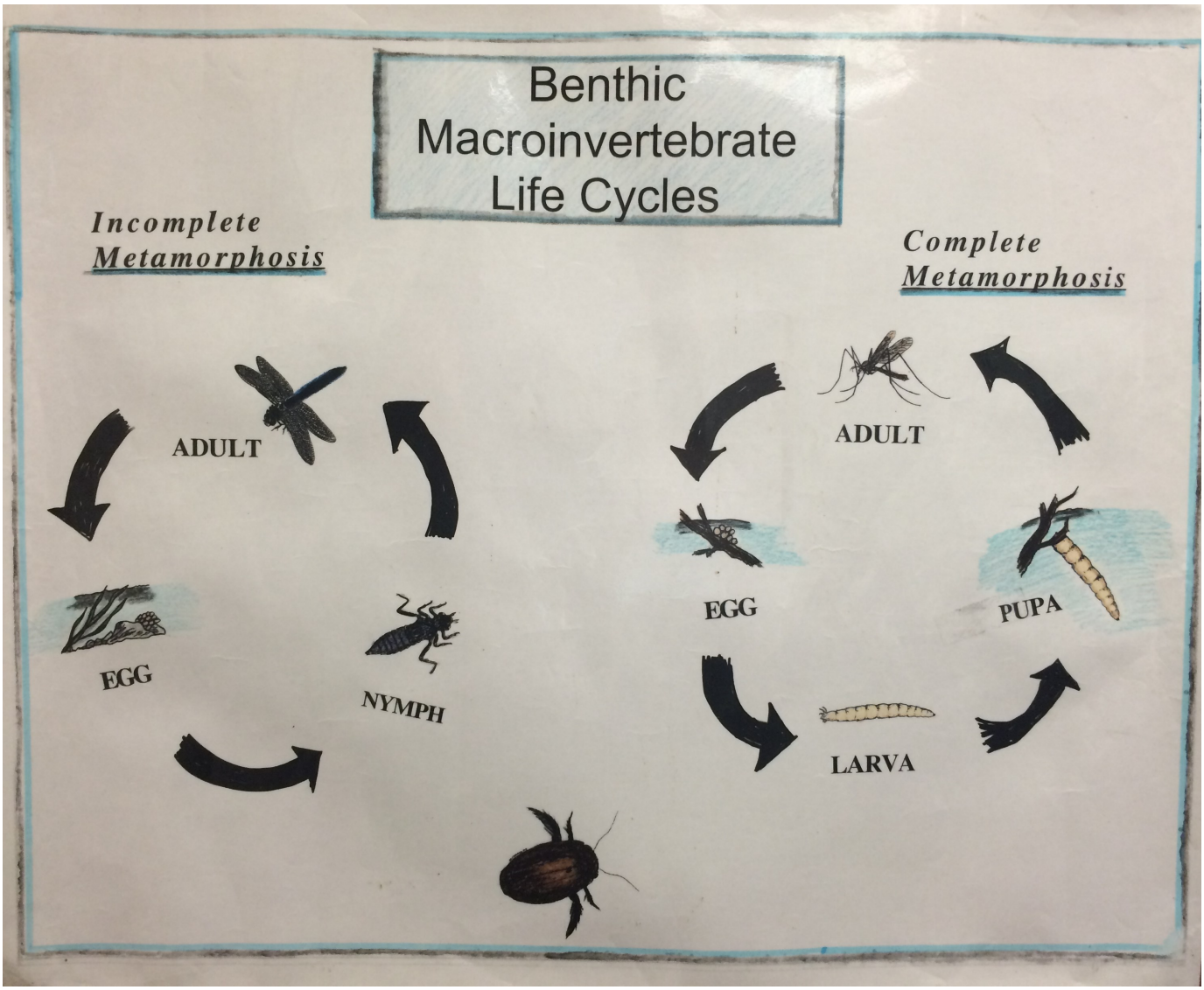
Before the first unit of the JSS program, a pre-survey is handed out to each student. On this survey there are questions retaining to this unit. There will be a post–survey handed out to the students at the end of the JSS program. This survey will have the same questions as the pre-survey. You can see if the students retained the information if the scores of each student increase from the time of the pre-survey to the post-survey.

Next Generation Science Standards

Performance Expectations
MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. **MS-LS2-4.** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. **MS-ESS3-3**. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• Analyzing and Interpreting Data • Engaging in Argument from Evidence • Constructing Explanations and Designing Solutions • *Connections to Nature of Science* Scientific Knowledge is Based on Empirical Evidence	• LS2.A: Interdependent Relationships in Ecosystems • LS2.C: Ecosystem Dynamics, Functioning, and Resilience • ESS3.C: Human Impacts on Earth Systems	• Cause and Effect • Stability and Change • *Connections to Engineering, Technology, and Applications of Science,* Influence of Science, Engineering, and Technology on Society and the Natural World

Metamorphosis Poster



What Have We Learned?

Grade Level: 6-8

Subject areas: Science, Environmental Education

Duration: 1 hour

Group size: 20-30 kids

Setting: Classroom

Key Terms: None

Appendices: JSS journal

Objectives:

The students will be able to describe and analyze key terms and ideas from all of the lessons that SFEG has taught the class over the past year.

Method:

Students will complete the post-program survey, review the lessons in their student journal, and participate in a Kahoot review game.

Materials:

- Kahoot website
- Student surveys (one per student)

Background:

Not much background for this lesson since it is a review over the last year. Briefly review lessons:

1. Watershed
2. Salmon Biology
3. Water quality
4. Salmon lifecycle
5. Riparian zones
6. Stewardship
7. Salmon species
8. Macroinvertebrates

Preparation:

Before the lesson, print enough surveys for all the students in each class.

Review and change the Kahoot game as needed for the year at create.kahoot.it. There will be two Kahoots per class one as a review of JSS content and one as a review of the year as a whole. Make sure both of these Kahoots are updated!

Procedure:

1. *(0– 10 minutes)* Students complete the post-program surveys immediately without consulting student journals. Collect the surveys as the students complete them.
2. *(10– 15 minutes)* Review the last unit (macros). Ask them to tell you some of the macroinvertebrates they saw. What group were they in? What did they tell us about the stream they live in?
3. *(15– 25 minutes)* Now comes the fun part. Have the class divide themselves into groups of less than 5. Each group MUST have a working smart phone with access to internet. Tell them for the next 10 minutes they have time to review their JSS journals and log into the game. Have them go to kahoot.it and log in the code (which you get once you, as admin, start the game).
4. *(25– 26 minutes)* After they have reviewed, refresh with them how Kahoot works. There will be a question on the screen. Then it will give you multiple choice answers that have a color and shape associated with each answer. These shapes and colors will show up on the students phones. The students must be the fastest group to click the right answer to get the most points. Tell them not to be to fast though, some of the answers may trick them.
5. *(26– 45 minutes)* Run through the Kahoot game. Encourage the teams and have fun.
6. *(45– 58 minutes)* Once The first Kahoot game is done, repeat step 4-5 with the second Kahoot game.

Extension:

If you get done early, ask them what they thought of the JSS program?

Evaluation:

Before the first unit of the JSS program, a pre-survey is handed out to each student. On this survey there are questions retaining to this unit. After this last unit you will collect the post–survey. Now you have to pair each students pre-survey and their post-survey and staple them together. Grade all the surveys (pre and post) and record the scores in an excel sheet. Then calculate the % change.

Next Generation Science Standards

Performance Expectations
MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• Analyzing and Interpreting Data • Engaging in Argument from Evidence	• ESS3.C: Human Impacts on Earth Systems	• Stability and Change • *Connections to Engineering, Technology, and Applications of Science,* Influence of Science, Engineering, and Technology on Society and the Natural World